

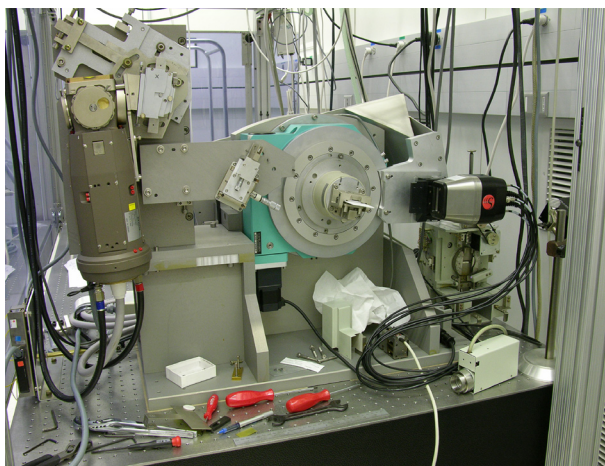
## SI-Traceable Measurements for X-Ray Metrology SRM® Development

### Facilities

MSEL researchers have established an X-ray Metrology facility located in the Advanced Measurement Laboratory at NIST. A 36 m<sup>2</sup> laboratory, maintained at  $20.00 \pm 0.02$  °C, houses the SI-traceable, X-ray diffraction measurement instrument—the Ceramics Division Parallel Beam Diffractometer (CDPBD). An additional 36 m<sup>2</sup> of laboratory space contains the Ceramics Division Powder Diffractometer (CDPD) and the X-ray Optics Evaluation Double Crystal Diffractometer (XOEDCD) and control systems. These combined instruments provide SI-traceable measurements for powder diffraction (PD), X-ray reflectometry (XRR), and high-resolution X-ray diffraction (HRXRD) Standard Reference Material (SRM) development.

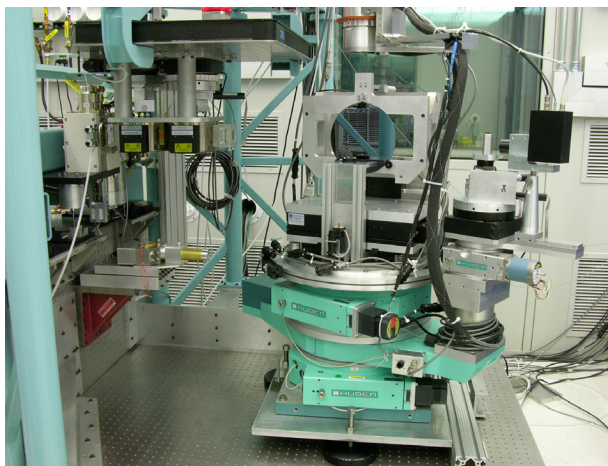
### Significance

Development and cost-effective manufacturing of advanced components and devices in many industries—construction, pharmaceuticals, and microelec-tronics, for example—depend critically on accurate knowledge of materials structure. Such determination requires SI-traceability and inter-tool reproducibility that are achieved by instrument calibration with certified reference materials or calibration services to assure accurate and precise measurements.



The CDPD under construction: will be used for homogeneity and microstructure analysis of PD SRMs.

SI-traceable X-ray diffraction measurements on the CDPBD require calibrated optical angle encoders and X-ray wavelengths traceable to primary frequency and length standards. Angle traceability is provided through the method of circle closure using a nulling autocollimator in conjunction with an optical polygon. Wavelength traceability is provided through reference crystals from the international Avogadro Project and the NIST Physics Laboratory Lattice Comparator. The performance of X-ray optics that provide a parallel beam are examined using the XOEDCD; data from this instrument provide wave-length character and alignment information requisite for their use in the CDPBD. The CDPD features a fully encoded, high-precision goniometer assembly as well as advanced optics. It provides the means to test PD SRMs for homogeneity and to collect high resolution data for microstructure analysis.



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